

QTC



Messages and news from RASA
The Radio Amateur Society of Australia

April - June 2021

Class Licencing: Updates

SMD: a beginners guide

Build a simple 2m vertical

HF antenna for small yards

EMR Safety Calculator

**DMR: Write your own Code
Plug**

PerthTech!

...and more...

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Email us at info@vkradioamateurs.org

Cover picture credit: Ian VK3BUF

QTC from the Editorial Team

Welcome to our latest edition of QTC.

In this edition, we report on the recent RASA-ACMA meeting to discuss the ACMA's proposed changes to amateur radio licencing.

It seems that ACMA have revised their position on interference protection under a class licence... and we give you updates on a number of other important topics we discussed with ACMA officials.

RASA also continues to lobby for 50-52MHz for Standard licencees and 1kW for Advanced Licence holders.

We also continue to highlight the importance of a sector liaison committee (or similar) with ACMA. Having two separate representative bodies not working cooperatively is simply not practical.

Ian VK3BUF brings us fascinating articles on working with Surface Mount Devices and building a 2m vertical, and Glenn VK4DU shows us how to program a DMR radio.

RF safety is an issue that impacts every amateur. David, VK2CZ presents his very useful excel based RF safety calculator.

Suburban building blocks are getting smaller, but that does not mean the end of HF. Paul VK2APA shows us some antennas designed for restricted spaces.

In other news we've been working behind the scenes to progress 2x1 contest callsigns.

Interference by a small group of outsiders has delayed the rollout further... we'll keep you posted via our email bulletins, Facebook and website.

We will continue to reach out to the WIA and seek collaboration and cooperation. If you're a WIA member and you support this position, please let their President and Directors know.

We've got other news on a new free resource for clubs: a folio containing helpful documents and guides for newcomers to our hobby. So, if your club is running a course, read this article and contact us for your free copies.

PerthTech is coming up in September. Thank's to Bob VK6POP, you can read all about it in this issue of QTC. RASA will be there and is also sponsoring some prizes too!

Well, we hope you enjoy this issue of QTC... as always, we welcome your feedback and ideas.

73,

QTC Editorial Team
info@vkradioamateurs.org



Worked All Continents....in 6 Minutes

By K1HTV, Rich Zwirko

This rather interesting article came across our desk... love it or hate it.... FT8 is making a splash!

On 17 Meter during the late afternoon on May 18, 2021, I completed WAC (Worked All Continents), using the FT8 mode, in 11 minutes.

Around 03:15 AM EDT the next morning, after awaking from a restless sleep and while still horizontally polarized, I turned on my Android phone. I connected to my shack computer and its 3 video monitors using the VNC app.

At that early hour (07:15 UTC) here at my VA QTH, I found 17 Meters was already open to Europe. I switched down to 30 Meter FT8 and proceeded to work some DX.

To my amazement, I was able to make FT8 contacts with all continents to complete WAC (Worked All Continents) in 6 minutes even! Below is the K1HTV log for those contacts, which may be a world record for WAC in the shortest time, at least for the FT8 mode.

(Courtesy Daily DX 19 May 2021)

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RASA Membership



**BEING HEARD
IS IMPORTANT**

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vkradioamateurs.org

We believe we should be measured by our achievements. And we can only succeed with your support, so thanks to all our members and supporters for helping us make this happen.

And thanks to everyone who has sent us emails with feedback.

We listen to our members and respond to emails and questions about our initiatives, policies and priorities.

Please support us by joining or renewing your membership today. It's just \$10 and its simple – [follow this link](#).

We have heard from a number of members who are not receiving our bulletins or emails.

Some of you are overdue with your annual membership fees.

Please drop us an email if you're not sure if you're membership is up-to-date and we'll get back to you.

Also, please check your spam or junk folders; some ISPs and mail clients are very aggressive with how they categorise incoming emails.

QRM Kill Kits

Ferrite kits to suppress unwanted noise in your shack. Click the image to head to our online shop.



Build a simple DF Loop to help you localise and pinpoint the source of the noise. Click on the image to head to our online shop.



RASA's Key Achievements: 2019-2021

- ✓ Successful negotiation with ACMA for [2*1 Contest Callsigns](#)
- ✓ Evidence based, professional proposals to ACMA – [60m](#) and [1kW](#)
- ✓ [QRM Guru](#) – reducing/eliminating QRM - on-the-ground help for amateurs
- ✓ QRM Kill Kits – Noise suppression with Ferrites & DF Antenna kits
- ✓ Club visits – 15 clubs across five states
- ✓ Donations of ten [QRM Club Kill Kits](#) to clubs (value \$1,600)
- ✓ [Welcome to Amateur Radio Guidebook](#) for newcomers
- ✓ [QTC e-Magazine](#)
- ✓ [VKRegs](#) “plain language” reference to the LCD
- ✓ [Amateur Radio Tech Support](#) online portal
- ✓ Donations and support for events: Antennapalooza, ILLW, OCDX Contest
- ✓ Responsible financial management with a healthy surplus each year
- ✓ Prepared a detailed and practical submission in response to the ACMA Consultation paper on Class Licencing
- ✓ [Welcome Pack for newcomers](#) (see this issue for more details)

All this for just \$10 per year.

Help us provide all our resources to all VK Radio Amateurs for free.

ACMA Update



29 June 2021

Amateur radio update: June 2021

In our third amateur e-bulletin for 2021, we provide an update on:

- the review of non-assigned amateur licensing
- 2x1 contest call signs
- consultation on proposed changes to class licences to harmonise EME requirements
- accreditation arrangements.

Update: review of non-assigned amateur licensing arrangements

In February, we consulted on our [review of non-assigned amateur and outpost licensing arrangements](#), which included proposed changes to accreditation arrangements for amateur beacon and repeater assignment.

We would like to thank everyone who provided feedback. We received over 800 submissions, which we are now considering.

We intend to publish submissions in Q3 2021, along with our response to the key issues raised.

Update: 2x1 contest call signs

Arrangements for issuing 2x1 call signs (for example, VK1Z) to use in contests are currently being developed.

Further information about the proposed application process and how 2x1 call signs will be issued will be provided in an upcoming e-bulletin.

Outcome: consultation on proposed changes to harmonise EME requirements

We have published the outcome of our consultation on proposed changes to how our electromagnetic energy (EME) regulatory framework applies to class licences.

This includes a proposed change to the Radiocommunications (Overseas Amateurs Visiting Australia) Class Licence 2015 (Overseas Class Licence) that would require overseas visiting amateurs to comply with the EME general public exposure limits set out in the Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 GHz (ARPANSA Standard).

Following consideration of submissions, we have decided not to make this change to the Overseas Class Licence.

We will keep investigating the most appropriate longer-term EME-related requirements for domestic and overseas visiting amateurs as part of our review of non-assigned amateur licensing arrangements.

Outcome: accredited persons scheme

Following our consultation, we have made legislative instruments for the accreditation to issue Frequency Assignment Certificates (FACs) and Interference Impact Certificates.

In general, these instruments continue the arrangements in place under the accredited persons scheme (the AP scheme).

One significant difference is that the AP scheme now allows the ACMA to accredit a person to issue FACs for a single, specified licence type, such as assigned amateur licences (beacon and repeater) and at a lower application charge than for 'full' accreditation.

We also intend to publish technical and administrative guidance to improve the efficiency of the assignment process for assigned amateur licences. We'll provide more information on this in subsequent bulletins.

Instruments for the AP scheme are:

- Radiocommunications Accreditation (General) Rules 2021
- Radiocommunications Accreditation (Transition) Rules 2021
- Radiocommunications (Conditions of Frequency Assignment Certificates – Apparatus Licences) Determination 2021
- Radiocommunications (Conditions of Interference Impact Certificates) Determination 2021.

News from the Australian Maritime College on Recognition of Prior Learning (RPL) and 2 x 1 callsigns



The Australian Maritime College - the ACMA's outsourced exam and callsign recommendation provider, has provided the following information on changes to RPL and 2 x 1 callsigns, which they have asked to be disseminated widely.

Amended Recognition of Prior Learning (RPL) instructions

Under certain circumstances, exemption(s) may be granted from one or more subjects in an amateur operator examination if a person holds equivalent, or higher, qualifications covering the appropriate portion of the relevant amateur syllabus.

RPL is dependent upon a number of factors, including the type of qualification and the time it was conferred.

After discussion with ACMA, the procedures for RPL were recently amended as follows:

Interview

Before arriving at a final decision, the appointed assessor may require the applicant to undergo an oral interview on all aspects of amateur radio theory, regulations and practical as part of the process of arriving at a formal determination.

The RPL instructions may be downloaded at:

<https://www.amc.edu.au/industry/amateur-radio/certificates/recognition-of-prior-learning>

2x1 Competition Callsigns

(24 June 2021)

AMC Amateur Radio is in the process of finalising an online callsign application system and the hobby will be updated when this comes available.

In the meantime, we would ask that people do not make any applications for these call signs because:

- The incorrect form is being used
- The fee has not been set
- Call signs cannot be reserved
- The monies will be refunded to you

Class Licencing – follow up news



The ACMA's proposed changes are detailed here:

<https://www.acma.gov.au/consultations/2021-01/review-non-assigned-amateur-and-outpost-regulatory-arrangements-consultation-012021>

The following issues were discussed.

The ACMA published their Consultation papers on the 3rd February 2021.

RASA immediately conducted a review and on 10th February we published our first ***“Interim Position Statement”***.

As the name suggests, this paper was an interim position and was modified a number of times based on feedback from the Amateur community.

Our final submission to ACMA may be found [here](#).

ACMA confirms that interference protection will not change under a class licence

At ACMA's request, RASA attended a teleconference with ACMA managers and staff on the second of June 2021 to discuss RASA's position on the ACMA's proposed changes to amateur radio licencing.

Interference protection

RASA's view is that ACMA must maintain their current position as an impartial arbiter for interference issues.

ACMA advised that the level of interference protection provided under any proposed class licence would effectively be the same as the current apparatus licence arrangements.

The lack of interference protection under a class licence was RASA's principal objection to the ACMA class licence proposals.

Definition of terms in the Class Licence

The term *Maximum power spectral density* needs to be defined in the proposed class licence.

ACMA agreed that this would be considered.

Sector liaison

RASA's view is that, if the licencing changes are implemented, there needs to be a sector representative committee created and that it needs to meet with ACMA on a scheduled basis.

ACMA advised that they are considering alternatives.

Callsign database

RASA made the point that some form of online amateur callsign database is required if a class licence is implemented.

ACMA are aware of this view. They are looking at options, which may involve the current Register of Radiocommunications Licences or some other form of online arrangement.

This will need to be consistent with privacy requirements for the handling of personal information.

1 kW for advanced licencees

RASA's view is that there are no EMC or EMR reasons to prevent an increase of output power for advanced licencees to 1 kW PEP, and that this could be done concurrent with licencing changes.

There is strong support for this across the amateur sector.

ACMA noted that their FYSO commitment is to investigate the feasibility of higher power amateur operation and consult with the amateur community on options in Q2 2022.

50-52 MHz for Standard class amateurs

Similarly, RASA made the point that there is strong sector support to resolve the anomaly preventing Standard class amateurs from accessing the entire 50-54 MHz band.

ACMA are aware of the sector view and will consider the issue.

However, they noted that it did not form part of the scope of the review consultation.

Beacons and repeaters

RASA's view is that assignment of repeater and beacon frequencies is not working well and needs to be streamlined by translating the repeater bandplans into Radiocommunication Assignment and Licencing Instructions (RALI) – as used by commercial land mobile services.

ACMA agreed in principle. They are planning to develop draft Frequency Assignment Procedures (simplified versions of RALIs) for comment in the 3rd quarter this year.

Next steps

ACMA advised that they will update the amateur community, via an ebulletin in the next couple of weeks, on progress of their consideration of the review submissions.

The ACMA will engage further with the amateur community on the outcomes of the review and future licencing changes in the next few months.

EMR Safety Calculator / RF Safety Calculator

Last month, we published the new ARPANSA standard for limiting exposure to RF fields.

David VK2CZ was kind enough to write to us and tell us about his EMC/EMR calculator. This spreadsheet looks to be thorough and well thought out. It's definitely worth downloading and using to assess your own station's safety status.



Image: QRZnow.com

David writes:

Amateur Radio operators are required to perform EMR Safety Calculations, that control the safe exposure distances to controlled and uncontrolled radio frequency (or EMF) environments.

These safety calculations and resultant compliance requirements have largely become mandatory by most regulators. The operator can be asked to produce these calculations when requested by the regulator. The FCC introduced it in 1997, New Zealand in 2000 and Australia in 2002.

The following spreadsheet replicates ALL the regulators tables / formulas and complex safety distance lookup tables found in both the FCC, New Zealand and Australian requirements.

It also covers power levels in excess of that legally permitted, as well as the safety calculation for 60m (5MHz) frequency band (which is not part of any guideline currently). Please read the notes and exclusions in the spreadsheet notes page.

Download here: [RF EMR Safety Exposure Calculator](#) (xls)

This spreadsheet calculator addresses the Amateur Radio Operator RF Safety compliance obligations to the following guidelines/standards:

- Australia - Human Exposure to EMR: Assessment of Amateur Radio Stations for Compliance with ACA Requirements, May 2005, version 2.0
- USA - FCC Sup B to OET B65 Ed97-01
- New Zealand - NZS2772-1999

A		B
1	Australian ACMA Calculation Guide. V6, updated logic around definition of Category 1 - 6Sep2017.	
2	The reference document used for this assessment is titled: "Human Exposure to EMR: Assessment of Amateur Radio Stations for Compliance with ACA Requirements", May 2005, version 2.0. Logic fixed for Category 1.	
3	The user is recommended to read the assessment guide, noting that this calculator will provide matching or slightly conservative safe distance estimates to that shown in the ACMA Document. This calculator is not a substitute for the graphical or detailed site analysis shown in that guide.	
4	This calculator uses Peak Envelope Power (PEP) at the transmitter output to perform its calculations.	
5		
6	The known shortcomings of the ACMA document are:	
7	The ACMA safe distances shown on the bands of 50Mhz and higher do NOT comply with the EMR math calculations. Specifically, EMR safe distances for frequencies above 50MHz are all loosely capped at 50MHz, ie. changes in frequency above 50MHz are ignored. Oddly, frequency of operation on HF is factored by the ACMA EMR Guide.. (and this calculator of course).	
8	The ACMA safe working distance in this 2005 version have almost doubled from those originally published by them in 2002. Please check for more recent updates. The 5MHz band is not part of the ACMA guide, but IS INCLUDED in this calculator.	
9	Mobile stations and point to point links now appear to be included in the 2005 Guide, noting they were specifically excluded from the 2002 Guide.	
10		
11	New Zealand Calculation Guide, V6, updated logic around definition of Category 1 - 6Sep2017.	
12	The reference document used for this assessment is titled: "Amateur Radio Service: Self assessment of Compliance with the requirements of NZS2772"Part1:1999	
13	The user is recommended to read the assessment guide, noting that this calculator will provide matching or slightly conservative safe distance estimates. New Zealand has largely adopted the ACMA guidelines, the 5MHz band is included here. The 136KHz band is excluded.	
14	This calculator uses Peak Envelope Power (PEP) at the transmitter output to perform its calculations.	
15		
16		
17	USA FCC OET Calculation Guide	
18	The reference document used for this assessment is titled: "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields". FCC Office of Engineering & Technology Supplement B Edition 97-01 to OET Bulletin 65 Edition 97-01, dated November 1997.	
19	The user is recommended to read the assessment guide, noting that this calculator will provide matching or slightly conservative safe distance estimates. This calculator is not a substitute for the graphical or detailed site analysis shown in that guide.	
20	This calculator uses Peak Envelope Power (PEP) at the transmitter output to perform its calculations. It include the 5MHz band, noting regulatory power limits apply.	
21		
22	Please do the manual verification requested in tables 18 through 31. Please verify for additional updates.	
23	The known shortcomings of the FCC document are:	
24	The FCC safe distances shown on the bands of 50Mhz and higher do NOT comply with the EMR math calculations. Specifically, EMR safe distances for frequencies above 50MHz are all loosely capped at 50MHz, ie. changes in frequency above 50MHz are ignored. Oddly, frequency of operation on HF is factored by the FCC EMR Guide.. (and this calculator of course).	
25		
26	Disclaimer	
27	This spreadsheet is not warranted nor guaranteed. No liability accepted, please verify your calculations with published guides. All the best, David Burger (k3hz@jeec.org)	
28		
FCC Sup B to OET B65 Ed97-01 ACMA Cover Letter Jan2013 Australia - ACMA 2005 New Zealand NZS2772-1999 NOTES +		

Screen shot of David's spreadsheet

Note that amateurs are required to comply with EME/EMR guidelines published by the ACMA – these are explained at: <http://vkregs.info/electromagnetic-radiation/>

David's spreadsheet will be very useful if your station is classified as *Compliance Level 2* – under this classification you are required to prove that your station meets the Australian Standard.

Can we justify more bands?

The WIA recently published their response to the ACMA five Year Spectrum Outlook (FYSO).

RASA's view is that, in the current environment, any expansion to existing amateur allocations in Australia is highly unlikely. Indeed, we would suggest that there is no justifiable demand for additional allocations (other than 5MHz).

On this basis, RASA offers the following comments on the WIA submission (WIA sections in red).

The WIA intends to seek expansions to amateur bands in the 3-12MHz segment over the next 5 years for Australian amateurs, at least in alignment with international allocations

Comments

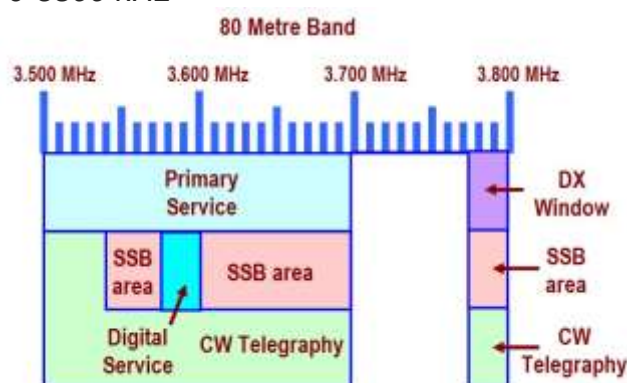
Large sections of the 7 MHz band are quiet, especially during the day, even on weekends. There is ample space available at peak usage times around late afternoon/early evening. 7200-7300 kHz is little used....

It is rare to hear more than one SSB conversation on the 10 MHz band during the day. Of course, the digital segment around 10136 kHz is very busy with FT8 stations...but that is only 3 kHz wide.

In general, the 40 and 30m bands are not particularly busy. Whilst there is some interference from Over The Horizon Radar, it certainly can not be classed as "harmful"* in the ITU sense.

Can we expand our allocations between 3 and 12 MHz?

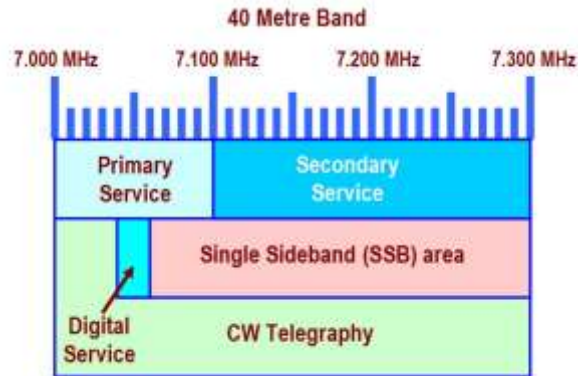
80m – 3500-3700 and 3776-3800 kHz



As we have discussed previously, there are thousands of Australian commercial assignments from 3700-4000 kHz.

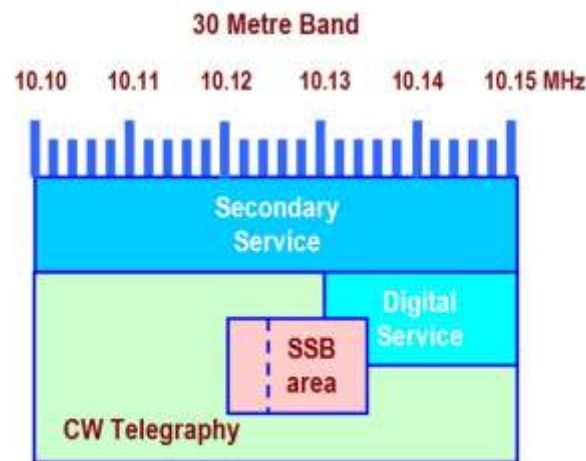
As already confirmed by ACMA, there is no possibility of an expansion of 80m in the foreseeable future.

40m – 7000-7300



Australian amateurs already have access to the entire Region 3* allocation of 7000-7300 kHz. We don't fully use what we have now.

30m – 10100-10150 kHz



Again, we have access to the entire Region 3* allocation, *and* we are able to use voice modes....a privilege denied to our overseas colleagues.

We could increase our allocations through either the granting of an extension to the 40 and/or 30m bands and/or the establishment of new bands.

However, this can *only* be accomplished at an ITU World Radio Conference....and this is a long, drawn out process* that will take at least a decade, if not longer.

So, as it stands, even if ACMA wanted to give us more bands between 3 and 12 MHz, they can't.

The amateur service has faced a significant reduction in access to UHF spectrum over the past 10 years. The overall impact has been a net 76% reduction in usable spectrum in many locations across Australia for many types of amateur service communications.

Comments

As we know, spectrum above 70cm is fantastically valuable. The ACMA recently auctioned spectrum for 5G mobile services in the 26 GHz band. The auctions generated **\$647M in revenue**.



5G is coming...

The amateur service has Secondary status in all of the UHF and SHF bands identified by the WIA.

Our Secondary status, combined with our very low levels of utilisation means that we can no longer justify large UHF/SHF frequency allocations in bands where we are a Secondary service (i.e. most bands above 2m...).

We acknowledge that this is unwelcome news, but it is the reality, unfortunately.

Alas, there is no room for sentimentality in UHF and SHF spectrum planning. There is simply too much money at stake.

Extension of operating privileges for AOCPS class licensees to include access to the 50-52 MHz band.

RASA has actively lobbied ACMA for access to 50-52 MHz by standard class amateurs since 2019. This is reflected in our submission to the recent ACMA consultation on licencing. We are pleased to see that the WIA supports our position.

Primary status 7100-7200 kHz

The WIA requests the ACMA conduct a further review of the defined usage of 7100-7200 kHz in the Australian Radio Spectrum Plan.

RASA raised this anomaly with the ACMA some time ago. We support this change, although we understand that the ACMA no longer allocate fixed and mobile services in this band.

Conclusion

As we have said in numerous articles, amateurs need to apply a pragmatic approach to our spectrum and the relationship with ACMA. We can't just put a submission to ACMA asking for more bands with no reasoned justification.

ACMA use professional automated radio monitoring systems to inform their decisions on spectrum management. They understand the utilisation of various bands very well.

Bland, unjustified statements to the regulator that "use has increased" are simply not sustainable in a modern spectrum management environment. Such claims serve only to diminish AR's reputation with the regulator.

What amateurs need are **facts**, not spin and false hope.

RASA will continue to lobby the WIA for a more collaborative approach to sector communication with the ACMA.

Indeed, at least two WIA Directors have indicated a willingness to open a line of communication. As always, we welcome feedback and questions.

PS Get on the air....!

**For more information on ITU issues, see*

<https://vkradioamateurs.org/amateur-radio-spectrum-management/> and

<https://vkradioamateurs.org/inside-the-itu/>

Meanwhile...

5G Mobile uptake progresses across the globe, report claims

(from the Critical Comms newsletter)

The state of the fifth generation of wireless (5G) subscriber adoption has tightened up significantly, as global wireless 5G connections for Q1 2021 have been adjusted to 298 million, according to 5G Americas, a wireless industry trade association.



Revised data provided by Omdia indicated the world added **79 million 5G connections** between Q4 2020 and Q1 2021, as wireless subscribers continued to **adopt 5G at two and a half times the rate of subscriber growth as 4G LTE**.

With global pandemic impacts levelling out as vaccinations increase and work and commuting patterns normalise, 5G remains on pace in 2021 to nearly triple the number of connections it added in 2020, reaching 633 million globally by the end of the year.

Additionally, nine 5G networks went live globally in Q1 2021, bringing the global total up to 172 networks, according to data from TeleGeography.

That number is expected to reach 273 by the end of 2021 and 313 by 2023.

Forward projections for 5G and 4G LTE from Omdia remain healthy, with estimates of global 5G connections reaching 4.6 billion in 2026.

Image credit: ©stock.adobe.com/au/areebarbar

Letting the smoke out...

Would you like to see the video that accompanies the front cover image this quarter?

<https://www.youtube.com/watch?v=IBnklABKY24>

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Flex-6600 from \$7,075

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Antennas for small blocks – Part 1

By Paul Anslow VK2APA

New and experienced amateurs often face challenges when it comes to selecting and installing antennas on the ever-shrinking suburban block.

Operating in suburbia also comes with other challenges with an increasing noise floor and interference (QRM) from the worlds ever increasing dependence on technology.

There is also the problem of neighbours and family who may not appreciate the beauty you see in your amateur radio antennas.

It is not all bad news. Radio amateurs are a clever bunch and have found ways to combat the issues of suburban operation and that is what we will cover in a series of articles over the next few QTC issues.

Many Japanese amateurs you hear and work are using base loaded whip antennas, Magnetic Loops etc. from apartment balconies.



HF Receiving Antennas

Amateurs spend more time listening than they do talking, so first we will take a look at some specialised receive antennas for that purpose. Generally a good transmit antenna makes a good receive antenna.

Before reading further, please understand that it isn't mandatory to have separate antennas for receive and transmit. Until a couple of years ago, I was satisfied using antennas for both, but after moving to a semi-rural location, I decided to experiment with active receive antennas to help combat the occasional QRM problems from a nearby above ground 11kV feed. If you do have QRM issues I do recommend you visiting [QRM Guru](#) and following the process found at the Start Here menu.

There are advantages in having a separate receiving antenna such as feeding multiple receivers, using an active splitter - handy for monitoring for band openings. Some active antenna designs have properties such as directivity or inherently have low noise pickup. Some are small and unobtrusive.

HF Miniwhip Active Antenna

Roelof, PA0RDT developed and designed a compact active antenna capable of receiving over the range 10kHz to 30MHz. Roelf's antenna makes use of E fields which is less sensitive to noise. The antenna's performance at VLF, LF and MF is excellent and at HF acceptable. The antenna is small and needs to be mounted 2 to 3 meters above ground. It is important that the shack has a reasonable RF earth and that the power supply used is clean.

The Antenna co-ax cable at the receiver end uses a small Bias T circuit which allows power to

be connected to the antenna and separates the RF output for the antenna, all using just the Co-Ax cable. This arrangement is often referred to Phantom Power.

I took a risk and bought a kit on Ebay and also bought one that is prebuilt. The kit is an easy build and uses through hole components. A simple waterproof enclosure is required and electrical conduit and end caps works well.



A kit version of PA0RDT HF Miniwhip Active Antenna

For me, the Chinese Ebay ready built version worked as well as the kit version.

For more information and how to build your own visit [VK6YZF's](#) page.

HF Active Loop Antenna

Minikits is an Australian speciality manufacturer and supplier of electronic kits and components for the experimenter. Their HF Active loop Antenna is a well-designed product which performed better than the Miniwhip Active Antenna.



An Ebay Chinese version of the PA0RDT Miniwhip

The Active loop is available as a pre-assembled Printed Circuit Board (PCB) or a kit.

The Kit version requires skills in soldering surface mount components – refer to Ian's VK3BUF article "Surface Mount Devices: a beginners guide" in this issue of QTC.



Both the pre-assembled and kit versions require a trip to Bunnings for some irrigation pipe and fittings and a bit of simple assembly. See the photo for the loop.

Set up as in the photo, the signal strength on 40M was almost comparable with a 40M dipole at 8 meters. A lower noise floor makes a difference in readability and is far more important than losing an S unit. I have found overall the antenna is as good or often better than a dipole. On 80M and lower the antenna is a great performer. I was impressed and immediately started making plans on using an active splitter so that I use the loop with other receivers.

Active Loop Antennas are really useful with online SDR receivers or for when frequency agile monitoring is required.

For more information on the Minikits HF Active loop Antenna visit the [Minikits webpage](#).

Active RF Switch

Some transceiver models have the capability of separate Tx and Rx antenna connections. Where this is not provided there is a solution.

Minikits Active RF Switch – click [here](#) - provides automated switching using a PTT connection to switch between antennas and also “Phantom Powers” the HF Active Loop Antenna.

The RF switch is available as a pre-assembled unit or a kit.

Next

In the next edition of QTC we will explore transmitting (and more on receiving) antennas.

Support

We remember how hard it is when first staring out in Amateur Radio....

[The Amateur Radio Tech Support Service \(ARTS\)](#)

is an online Knowledge Base with a ticketing support portal. It is aimed at newcomers and provides a selection of Knowledge Base articles to help newcomers as they get started in the hobby. For more information, click on the logo.



Disclaimer

The above is based on my experience - your experience may be different.

Neither I nor RASA have any affiliation with Mini-Kits.





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» Auburn: 15 Short St 02 8748 5388

Queensland

» Virginia: 1870 Sandgate Rd 07 3441 2810

South Australia

» Prospect: 316 Main Nth Rd 08 8164 3466

Products also available through our regional reseller network & Leading Edge electronics stores.



QRM Guru

In this issue will be presenting a few short articles on some activities that have been going on locally, as well as internationally in the domain of RFI and QRM.

DXZONE BEST LINKS OF 2020

All of us here at QRM Guru and RASA are very proud that DXZone have rated an article by Ian, VK3BUF as one of the best online Amateur Radio links for 2020.



Articles on QRM Guru, including Ian's, have been translated into Dutch, Greek, Italian and have also been seen on many other international sites.

Ian's article "[The Truth about Ferrites](#)" has been read over 16,400 times across 88 countries since it was published on 12th February 2020.

Congratulations Ian. We understand Ian's work with QRM Guru was nominated for a WIA Merit Award. We'll be watching to see how the judges rate the nomination.

Read more about this story [here](#).

SOLAR PANELS: German Regulator takes action.

The German Federal Network Agency has taken action against a make of solar panel optimizer that has been causing radio interference.



A translation of the VERON post reads:

The German Bundesnetzagentur (BNetzA) reports in its official publication Amtsblatt 9 that a device from SolarEdge does not comply with the EU Electromagnetic Compatibility (EMC) Directive. BNetzA indicates that the EU declaration of conformity is not in order and that the interference levels are too high. BNetzA therefore imposes a market-restricting measure on SolarEdge.

Read more about this story [here](#).

QRM from Power Line Communications

This is a great example of RASA and the WIA (thanks Ron) working collaboratively for the benefit of the hobby.

Ron VK3AFW is the WIA representative on Standards Australia committees TE-003/19 and TE-003, both of which deal with radio interference standards.

At the request of the committee, Ron is seeking feedback on any instances of Power Line Communications (PLC) interference experienced by Australian amateurs.

Ron advises:

There are two areas where PLC is used or has been used, power company distribution and transmission lines and in-home power wiring. The latter WiFi extenders cost from around \$50 to \$200. Both are potential sources of interference, especially on HF but the home units could be everywhere.

If you have any recent interference issues from PLC please respond briefly. I'll contact you if more detail is required.

Read more about this story [here](#).

INTERNATIONAL SUPPORT: QRM Guru assists DX operators with QRM issues

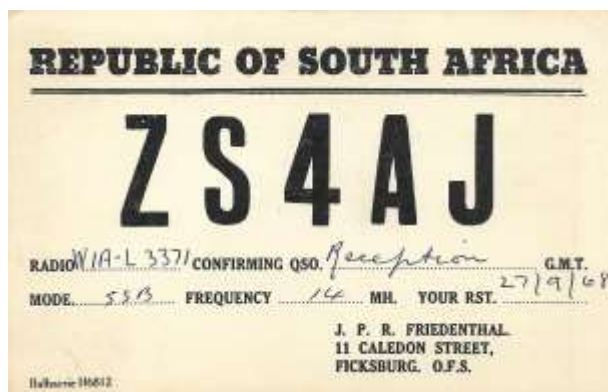
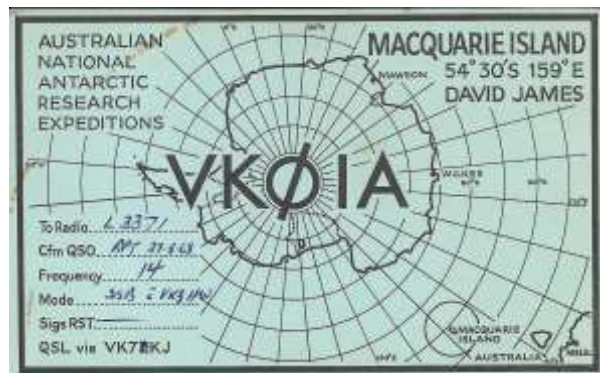
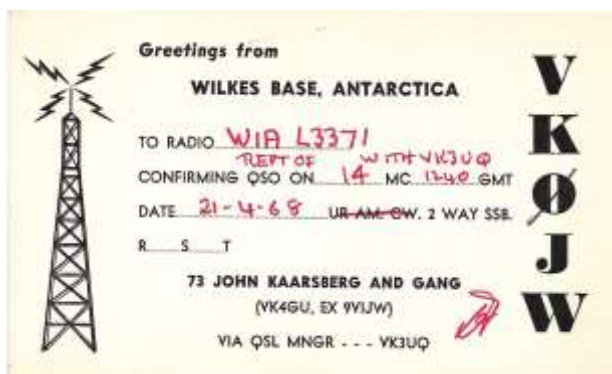
QRM Guru is now linked to the Amateur Radio Tech Support (ARTS) ticketing system. This enables users from VK and around the world to raise support tickets if they need a little extra assistance in working through the process.

As word spreads, we are seeing more international amateurs using QRM guru and requesting support via our online ticketing system.

ARTS is a great example of how a member based organisation can use a Help Desk Ticketing System to provide real value to its members.

You can visit ARTS [here](#).

Thanks to Colin VK3NCC for sending us a few more QSL cards from his collection.



PerthTech 2021

WA Amateur Radio News announces PerthTech 2021: weekend of Saturday 23rd October



PerthTech is a symposium of technical presentations of interest to Amateur Radio enthusiasts.

We'll be covering a wide range of topics on Saturday, followed by a sundowner for those who are able to stay. Presenters travel from across Australia to attend this event.

On Sunday we'll be offering practical workshops at various locations around Perth. These workshops are usually aligned with some of the presentations.

The venue we've selected has more space available to us than in previous years, offering us greater flexibility. The BIG new thing for 2021 is that you can stay onsite overnight in your caravan or camper. There will be an informal activity on Friday night for campers – more on that later.

Gidgegannup Recreation Club is a modern sport and recreation facility in the Perth Hills, about 45 kilometres North-East of the Perth CBD, along Toodyay Road.

The Perth Hills in Spring are a delight, where wildflowers abound. The location is about 15 minutes from the Avon Valley, 20 minutes to the Swan Valley wine region, and there are several National Parks and Nature Reserves within a 20-kilometre radius.

Although there is no public transport to the venue, it's easily accessible by car, about thirty minutes from Perth Airport.

While we're expecting that a good number of locals will attend PerthTech, we want to make others feel welcome too.

Visitors from outside of W.A. are invited to register and attend. In fact, there's a special prize draw for interstate and long-distance attendees.

QTC Apr-Jun 2021

There are accommodation options in the area, with motels and caravan parks within a twenty-minute drive, and a variety of chalets and B&Bs in the area. There is also on-site caravan parking. We may be able to arrange home hospitality on request. But no promises.

PerthTech is essentially a free event. But we do charge a \$20 entry fee which covers your lunch and a couple of other incidentals. The actual cost of staging PerthTech is more than twice that.

So how do we do it? We raise money. We gratefully receive donations, and we conduct a raffle.

This year the first prize in the raffle is an Icom 705 complete with backpack.



Please note that PerthTech is a ticketed event. Tickets are on sale online, and payment is via a secure payment gateway which accepts credit and debit cards, and PayPal.

Our website is www.vk6.net/perthtech. Information about PerthTech is updated regularly, and there will be links there for purchase of PerthTech entry tickets and Raffle tickets.

We look forward to seeing lots of you at PerthTech in October.

73, Bob VK6POP PerthTech Coordinator



The Radio Amateur Society of Australia inc.
BEING HEARD IS IMPORTANT
vkradioamateurs.org



RASA will be attending PerthTech. We look forward to providing updates on our activities and priorities. And as always, we want to hear what is important to you, so please come along with your questions and ideas.

We'll also be sponsoring a number of prizes on the day.

Welcome Packs: Free resources for Clubs

Does your club run training courses or exams for newcomers? If so, read on...

RASA has put together a free ***Amateur Radio Welcome Pack***. These packs comprise a portfolio folder which includes a number of useful documents and reference sheets.

Give your students some practical and relevant material to take away at the end of the course.

Included in this ***Welcome Pack*** are some documents and information sheets to help your students get started.



- Welcome to Amateur Radio Guide Book
- VK Regulations Handbook
- Getting started with Repeaters
- Australian Band Plan Quick Reference Guide
- Interference Resolution (QRM) Process Guide
- Useful Web sites information sheet

If your club is running a course and would like to provide these resources to your students just send us an email. This is a free resource. We only ask that you cover postage costs.

Have your Club President email us at info@vkradioamateurs.org

Now and again we include some interesting product developments from the commercial radio world...

Barrett releases the 4020 HF Radio Mailbox



Based on the success of Barrett's 2020 HF Fax and Data System, used worldwide for the past 15 years, the new [4020 HF Radio Mailbox](#) utilises new technologies to deliver seamless IMAP synchronised email over HF Radio and onto users' smart devices. A feature previously unavailable to the HF radio user.

The HF Radio Mailbox has been developed to meet the increasing demand by users to communicate via email from wherever they are, including remote and isolated locations connected only by HF radio, and a smartphone, tablet or laptop using existing and familiar email platforms such as Outlook, Gmail and Apple Mail.

Previously, each user was required to run PC based applications to send and receive POP/SMTP email via HF radio. The HF radio Mailbox requires no PC connection and handles all incoming and outgoing secure mail transfers, requiring the user to simply connect their smart device to the Mailbox's inbuilt WiFi hotspot and directly synchronise their mail account.

Any mail received by the Mailbox is automatically synchronised with the user's device and outgoing mail is sent via the HF radio using automatic link establishment to the radio gateway and on to the private/public domain mail server.

The small size of the HF Radio Mailbox makes it adaptable to a wide range of base station, mobile and even Manpack applications.

Build your own simple 2M vertical

By Ian Jackson, VK3BUF



This foldable 2M antenna is quick to deploy in the field

the horizontal plane. A full half of this antenna design is the support structure. Only the area above the coil radiates.

The antenna can be clamped, taped or cable tied to any available post or tower, as long as the area around and above the coil is free of obstructions.

The four sections that make up the antenna can pull-apart and fold up.

This is a vertically polarised antenna for the 2 metre band which does not require a ground plane or radials.

Variations of this basic design have been in circulation for many years. It is two metres in length and may be painted or left as plain white. This makes it an inconspicuous choice for homes where there are antenna restrictions. It is excellent for maritime situations where a good ground plane on a fibreglass vessel can be difficult to establish.

This particular version has been configured as a foldable antenna - just half a metre long when folded, which makes it back-pack ready for portable operation. It is very easy to build, requiring some RG58 coax cable, about \$15 of PVC pipe & fittings and little else.

It is a form of vertically polarised half-wave dipole, with the coil or choke wound from the feedline itself. Its assembly is not complicated. It would make for an excellent Club project where materials are purchased in bulk and several can be built by members at clubrooms. No complicated construction is required.

It has a lower angle of radiation than the basic quarter-wave ground plane, which gives the design some gain in



The four sections and feedline can fit within a back pack.

This is somewhat like a tent pole in a dome tent, as the short length of elastic attached to the radiator inside the pipework allows easy separation of each section.

The tube is white PVC 20mm pressure pipe, with three 20mm pipe joiners and a 20mm PVC end cap.

Except for the coil, the antenna is encapsulated entirely within the PVC tube.

The dimensions in this design give a centre frequency of **146.500 MHz**.

After construction, we connected the unit to a SARK antenna analyser, which revealed a close match at the target frequency on the first attempt.

Here, we measured a very low VSWR of **1.04:1**. Its characteristic impedance was measured at **51.7 ohms**. (circled)
A very good result.



The SARK analyser showed a near perfect match to the feedline

The components

The 20mm white pressure pipe is a common plumbing product available in several different lengths.



All of the parts needed to build the antenna

For convenience of transport and handling, two one-metre lengths were purchased from a Bunnings hardware store. These were subsequently cut in half to provide 4 x 500mm sections as seen in the adjacent image.

The same supplier also stocked the necessary 20mm pipe joiners and end cap.



A close-up of the smaller items

Here is a list of all items that make up the antenna:

20mm (i.d.) PVC pressure pipe	4 x 500mm long sections (2 metres total)
20mm PVC pipe joiners	x 3
RG58 coax cable	x 6 to 10 metres (as required)
Coax plug, PL259 & strain relief boot	x 1 (Use a BNC plug if you prefer)
Screw, stainless M3 x 30 long	x 1
M3 nuts and M3 washer	x 2 nuts x 1 washer
Blue crimp lugs	x 2
150mm section of elastic	x 1
Heatshrink tube 65mm x 130mm long	x 1

Most electronics stores don't stock large heatshrink, but local electrician's suppliers will have it.

Construction



Step 1 is optional. It is removing the printed text from the PVC pipe. This can be done with a tissue and some acetone. Two or three passes should return the tube to a plain white finish. The same process can be used to remove the barcode printing from the joiners and end cap.

For some people, the use of acetone can be a mild skin irritant and should be avoided. In such instances, the print can be removed from the plastics with light sanding.

Step 2 prepares one of the tubes for the coax cable by drilling two 6mm holes through one side of just one of the four tubes.

The first hole should be 25mm from one end of the tube and the second hole, exactly 50mm along the tube. These holes will serve to contain the feedpoint choke of the antenna - the RG58 coax must pass through them.



Step 3 entails marking the coax cable at two points, then removing a section of sheath and outer braid.

Point A in the adjacent image should be exactly **844mm** from the end of the cable. (Making a meaningful mark on black cable can be difficult. Gold/silver metallic marker pens are excellent for this. A dot of red nail polish may also suffice.)

Point B is **515mm** from the end of the cable. At point B, cut around the cable sheath, then along its



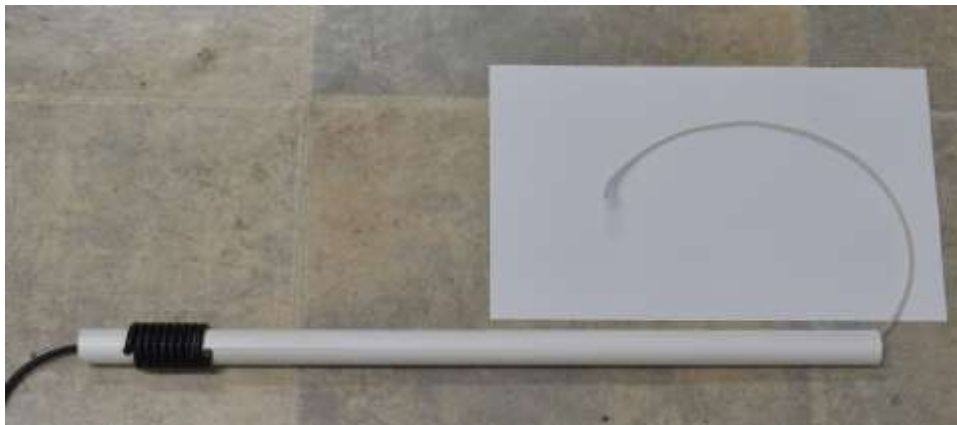
length, so the 515mm of black sheath can be removed. Then, using some sidecutters, remove all of the coax braid too, so that 515mm of centre core is now protruding from the cable end.



Step 4 requires the fabrication of the coil and is probably the most delicate phase of the operation. Feed **Point C** of the cable through the base of the pipe prepared in Step 2 and poke it through the first hole. Keep feeding it through until you can see the **Point A** dot marking, then add roughly an extra metre.

Now loosely wind the cable **NINE** times around the pipe before feeding **Point C** through the second hole. Keep stuffing the cable through the hole and stop exactly at the **Point A** marking dot. This dot **MUST** remain at the entry point to the second hole. Now we can work the nine turns tightly backwards, pulling all the slack back through the first hole.

Point C will be hanging out the end of the pipe and the coil should now look like this image.



Step 5 prepares the end of the antenna. At **Point C**, pare back a little of the clear insulation without exposing the copper centre. Just enough reduction to push the centre core into the rear of one of the blue crimp terminals, then crimp the terminal with pliers or a ratchet crimp tool. Ensure that the metal lug doesn't make electrical contact with the wire within the centre core.

Now tie one end of the elastic to the lug. This elastic will maintain tension on the conductor while it is being folded.

Step 6 is assembling the rest of the antenna. Place a pipe joiner over the cable and elastic, followed by a second section of pipe. The elastic



should be protruding from the end of the second pipe. With the end cap, drill a 3mm hole through the top and place the long screw through the cap.

This is simply an anchor point for the top of the elastic. Trim the bare end of the elastic into a point, and pass it through the second lug. With the top of the antenna assembled stretch the elastic a little before crimping the second lug level with the top of the pipe. Now it is OK to fasten the second lug to the inside of the cap.

After sliding the remaining two pipe joiners and pipe sections over the full length of the RG58 coax, the antenna should be physically complete. Put the coax plug on the end of the cable and give it a test. The VSWR on 2 Metres should be very low. Once this is confirmed, put the large heat-shrink section over the coil and heat it with a heat gun or powerful hair dryer gun.

An optional task can be to glue one side only of each of the pipe joiners with a squirt of super glue, so that it comes apart at one side only of the joiner when it is being folded.

You should now have a robust and functional vertical antenna for the 2 metre band.

If you do complete one of these antennas, send an email comment to info@vkradioamateurs.org and let us know how it performs.

Writing your own DMR “Code Plug”

By Glenn VK4DU

Digital Mobile Radio (DMR) is the most popular of the amateur VHF/UHF digital modes. The VK-DMR network uses 55 linked repeaters, sited all over Australia.

See <https://vkdmr.com/the-dmr-network/>

DMR radios

Unlike amateur transceivers, DMR equipment operates in a channelised mode.

DMR radios are designed to be programmed once by a radio technician and then used by non-technical, commercial users. They operate quite differently to normal analogue 2m and 70cm rigs.



Typical DMR commercial mobile radio

A few DMR radios can be programmed directly from the front panel, but there are too many channel parameters to change to make “VFO mode” really practical.

“Code plugs”

The programming files for DMR radios are known colloquially as “code plugs” – they are simply a computer file containing the parameters to be programmed into the radio. Each programming file works with its own programming software.

Some software will work across different radios, but most equipment requires dedicated software.

Why write your own code plug?

Writing your own code plug looks challenging, but it really isn't that complicated; any amateur with basic computer skills can do it.

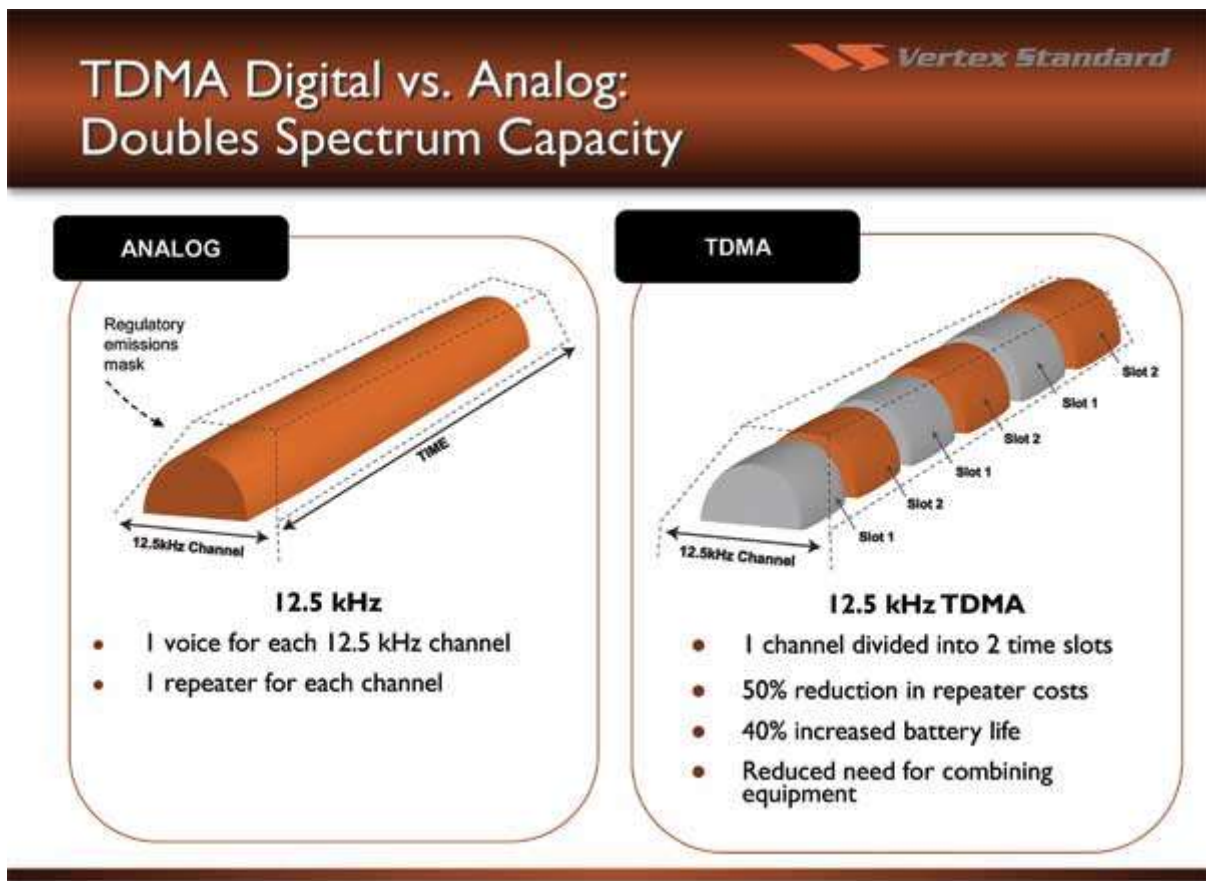
You could use someone else's code plug, but that is, frankly, self-defeating. AR is a technical hobby, after all....moreover, using a code plug from another radio sometimes creates radio firmware problems.

Writing your own code plug also provides a very good insight into how the DMR system works.

Slots and talk groups

DMR uses Time Division Multiple Access (TDMA) to provide two 30 ms “time slots” per 12.5 kHz radio channel.

Each time slot can carry independent voice conversations – this means that each DMR repeater provides two simultaneous voice channels – illustrated in the diagrams below:



Analogue vs. DMR (courtesy Vertex Standard)

Each time slot also has a number of talk groups (TGs)– these function as discrete channels within that time slot. Users on one TG will not hear those on another.

Each repeater on the VK-DMR network uses a number of TGs. Most of the TGs are linked between some or all of the 55 repeaters in the network.

Each of these TGs have to be programmed into your radio for the repeater you wish to use.

User ID and database

Every user on the DMR network has a 7 digit ID number - this is obtained on line from <https://www.radioid.net/>

The ID number must be programmed into your radio – it is sent with every transmission.

ID numbers are internationally coordinated, with the first three digits representing the user's country. VK uses 505, the UK uses 234, etc. The database is available online.

If you download all or part of the number database into your DMR radio, it will do an automatic lookup on the ID in every received call and, if it finds a match, show the user's name and callsign on your radio's display screen:



DMR radio showing received stations callsign and name

The database capacity varies between DMR radios – some only hold 1000 entries (sufficient for all active VK numbers/callsigns), but some Chinese radios can hold hundreds of thousands of numbers – which will allow storage of the entire worldwide DMR callsign database...

Radio parameters

Some physical parameters of DMR radios such as button functions and display backlighting can also be programmed using the software.

Programming the radio

The following instructions are general in nature. The physical layout of programming software varies widely between radio makes and models, but the parameters to be programmed are the same for all DMR equipment.

Connect the programming lead to your radio, and “read” it.

The software will show a new blank code plug.

The first task is to program your DMR ID. This will normally be found in the “settings” or “general” menu – labelled “radio ID” or similar.

Next, you need to program the TGs you will use. Refer to the list at <https://vkdmr.com/using-dmr/>

Some radios combine the TG and user ID lists, whilst other radios have separate lists.

After the TGs have been entered, you can then move to programming the actual DMR channels.

The following minimum information must be programmed for each channel:

- Colour code – this is always 1
- Time slot – 1 or 2
- Repeater rx and tx frequencies
- Power output (H or L)
- TG
- Channel name/alias to be displayed (normally repeater name/TG)

As discussed earlier, each repeater has a number of “channels” – each of which uses a separate TG. Repeat the procedure for each channel – only the channel name, the TG and the time slot will need to be changed. The tx and rx frequencies remain the same for each channel.

You will see the term “Zone” in the software – this is a commercial name for a group of channels. If you use more than one repeater, program each repeater in its own Zone.

A good way to check that you have the correct channels programmed is to use the DMR dashboard, at <http://rpt.vkdmr.com>

Watch the dashboard as you key up each channel in turn – you will see if each channel is using the correct TG and slot.

You can then program user ID lists, which need to be downloaded as excel files – Matt VK2FLY offers the latest VK user ID lists at: <https://arnsw.net/config-generator/>

Worldwide DMR user ID lists may be found on the internet at www.radioid.net

Once you have the radio operating correctly, you can customise button functions, set up scan lists, etc. Don't forget to adjust your tx audio level using the parrot: <https://vkdmr.com/parrots/>

Further resources

There are numerous DMR radio-specific programming videos available on YouTube. See Mr. Google.

Don't forget the VK-DMR website at <https://vkdmr.com/>

Get programming. It is very rewarding to set up your own radio.

Surface Mount Devices: a Beginners Guide

By Ian Jackson, VK3BUF

Electronics has passed through several revolutions over the decades. One such change has been the quiet but steady miniaturisation of components. Little by little the standard parts widely used in the 70's and 80's have become smaller.

Industry steadily phased out the need for components to be passed through holes in circuit boards and now place them on individual layers.

Circuit board manufacturing quality has also developed. What was once considered to be high-end fabrication standards have now become routine.

Component miniaturisation has allowed electronic products to become smaller and to be manufactured faster, and with higher levels of automation. Today, the real cost of our electronic products has fallen to levels we could only have dreamt of in our youth.



'Soldering' can mean different things to different people



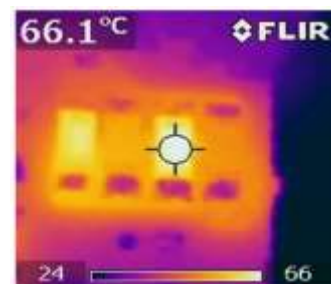
3 common chips. The ULN2003, the CMOS 4011 and the MAX232, All shown with their tiny Surface Mount Device (SMD) counterparts

rarely uses this convention. Unfortunately, there is little advice in Amateur Radio education that prepares candidates for what they will encounter when the cover is removed from any modern radio. Sometimes described as 'electronic sand', Surface Mounted Devices (SMD) are tiny, closely spaced and often unidentified.

Even if you are fortunate enough to locate a circuit diagram for your communications gear, it can be quite difficult to reconcile its schematic with the physical module it is supposed to represent.

It is fair to say that presently we all enjoy the benefits of this revolution. Mobiles, entertainment products, GPS technology and yes, Amateur Radio transceivers, have all been enhanced with features, portability, and power consumption.

Amateur Radio as a hobby has been largely unprepared for this change. Amateur exams still contain questions on resistor colour codes, even though modern manufacturing



Inside this LED driver 125mw resistors shown under infrared drew 300mw. All of these lamps failed after just 6 months.

In the quest to make products smaller, compromises have been made in three key aspects of electronic engineering.

Heat: The tiny surface mount parts have low surface area and poor scope for heat dissipation. We often see products that work well in cool weather, but will fail under heavy loads or on hot days. SMDs can literally slide off the board when they become sufficiently hot. By contrast, traditional through-hole fabrication is far more thermally robust because of the larger surface area and pigtail connection circuit boards.

Flex & Vibration: The traditional through-hole-mounted parts in circuit boards are quite tough, particularly with through-hole plating where the solder can literally fill the hole and anchor parts to both sides of a board. The copper pigtails on through-hole parts can flex a little between the component core and the supporting PCB. This architecture makes for tougher electronics, which is essential in the fields of automotive, marine and aviation technology.

By contrast, modules containing many SMDs will have a low tolerance for physical trauma. Lacking copper pigtails, parts are hard-bonded to one side of a circuit board panel. Any twist, bend or extreme vibration can put tiny cracks through resistors and capacitors, resulting in unstable operation or complete failure. The task of locating intermittent faults on SMDs is very difficult. All too often, entire boards must be discarded. An entire product may have to be written off because of a single cracked resistor 'somewhere' on a PCB, even though the offending part may be worth less than a cent.

Flashover: Any circuit board assembly certified for mains operation should be engineered with appropriate spacing between high voltage parts. This protocol is termed 'creepage and clearance'.

In the quest to make products smaller, designers frequently take short cuts.

Equipment may be great in a clean and dry environment. A little humidity combined with dust and high voltage potentials can cause catastrophic flashover and even fire, as we see on the cover of this magazine.



This 15V Plug Pack for a late model Microsoft Surface tablet suffered internal arcing and cooked itself after just 3 months.

Generally, the older through-hole PCB modules, with bigger track spacing and wider track widths can handle higher current with less chance of breakdown and arcing. Surface mount connectors on the edge of products such as charging and audio sockets only require a small knock to break away from the PCB material. This can be a very common point of failure.

Of course, all these problems can be overcome if surface mount boards have been properly engineered. PCBs can be mounted at multiple anchor points and perhaps sealed in epoxy resin or other environmental coating. When these precautions are not taken, consumer products may often be unnecessarily fragile.

Most amateurs will have a reasonable understanding of electronic basics, but many are not prepared for the reality of SMD miniaturisation and avoid working with it.

Unfortunately, this reluctance is compounded as we age, where sharpness of eyesight and steadiness of hand tends to decline.

The art of working with surface mount devices involves three distinct areas of discipline:

- **Recognising components**
- **Manipulating components**
- **Soldering and de-soldering techniques**

There are further challenges not discussed here, such as designing PCBs with SMDs and methods for fault-finding SMD assemblies. Both are large topics which are worthy of examination in future articles.

A modern electronics workshop carries many specialised tools for working with SMDs and the staff in such workshops will have the required expertise. Even then, the work can be difficult.

Most amateurs will have the limited SMD armoury of: a basic soldering station, a magnifying glass, a pair of tweezers and...not much else. There will be many instances where this is simply not enough. This article is not intended to turn experimenters into engineers. The methods discussed should serve as a useful guide for anyone attempting to work with SMDs for the first time.

Recognising Components

Within the vast realm of SMDs, IC pin spacings will vary between fine, very fine and microscopic, depending on the intended density of design. Discrete SMDs also come in different families of size. These categories of case style use 'identifier codes' which correspond with the height and width of each part.

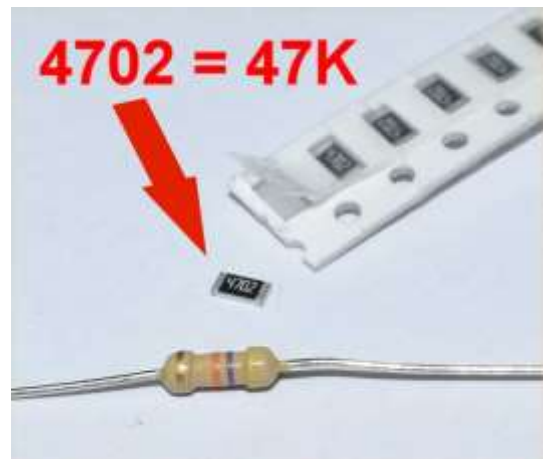
Resistor values & sizes

Resistors are usually marked with a four digit code, with the rightmost digit representing how many zero's to add to the first three digits.

In the adjacent example we see a device labelled **4702**, which equates to **470** plus **two zeros**, or **47000** ohms, commonly referred to as **47K**.

SMD resistors usually come packaged within a section of paper tape, or an entire reel. A thin film must be peeled back to release the part from the strip.

Manually un-packing these parts is best done in the bottom of a shallow white-plastic tray, as the parts are very easily lost.



Comparing a 1206 with a regular 1/4W resistor

The table overleaf shows the dimensions of common resistor packages, with the two highlighted rows being the most frequently used. There is a correlation between the package code and the device dimensions (in inches). For example, the **1206** device is **0.12"** long and **0.06"** wide.

Package	Size (inches)	Size (mm)	Wattage (apprx)
2512	0.25 x 0.12	6.30 x 3.10	0.50 (1/2)
2010	0.20 x 0.10	5.00 x 2.60	0.25 (1/4)
1210	0.12 x 0.10	3.20 x 2.60	0.25 (1/4)
1206	0.12 x 0.06	3.0 x 1.5	0.125 (1/8)
0805	0.08 x 0.05	2.0 x 1.3	0.1 (1/10)
0603	0.06 x 0.03	1.5 x 0.08	0.0625 (1/16)
0402	0.04 x 0.02	1 x 0.5	0.0625 (1/16)
0201	0.02 x 0.01	0.6 x 0.3	0.05

Capacitor sizes.

SMD capacitors are difficult to identify. Most SMD caps are completely unmarked. If a suspect or damaged cap must be changed, it cannot be tested in-circuit with a capacitance meter, as other nearby components will distort the reading.

A capacitor must be removed from a board before it can be measured. If damaged, it cannot be measured. Often circuit stages on PCBs are duplicated. An adjacent stage may be nearly identical, so a similar capacitor could be removed and checked. SMD cap voltage ratings are not shown. When replacing an SMD capacitor, try to use the highest available voltage rating for that specific size, just to be safe. Sometimes determining a cap value will be guesswork. If the cap is across a power rail, or near a voltage regulator, then it may be a common 100nf. Two caps next to a crystal are probably 15-22pf. If the capacitor is close to an IC, then try looking up application notes for that device as they may list appropriate component values for the circuit at hand.

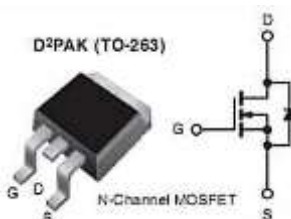
Transistors and FETs

Small SMD transistors are also difficult to work with. A large percentage are unmarked and those with markings are often obscure, like the SOT-23 device shown here.

Just by looking at a 3-leg device on a PCB, you can't tell if it is a FET, transistor, or even a diode where the third pin is unused. Transistor connections of Base Emitter Collector are not standardised. If the device has been burnt out, it is likely to be open circuit, making it impossible to identify.



If no circuit diagram is available, then the best way forward is to look for an intact device on the same PCB which appears to be performing a similar task. Carefully de-solder it, attach some hair-fine wires and place it on a handheld component analyser for measurement. Hopefully, the analysis will yield enough information for a compatible substitute to be sourced.



Mosfets are fairly universal in connections

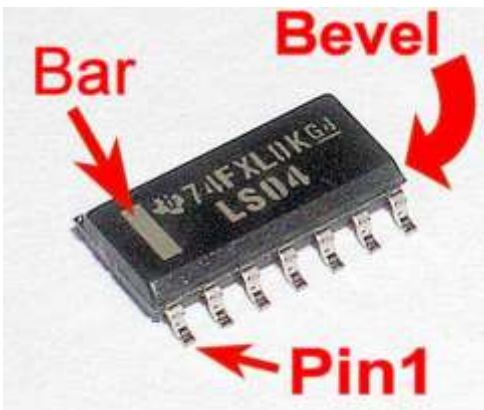
Most N-channel Mosfets seem to have standardised their pinouts for Gate, Drain and Source (GDS). Whenever it is in a package with three pins in a row, the leftmost will be the Gate, the centre pin (and mounting tab) will be the Drain and the right pin will be the Source.

When Mosfets fail, they tend to permanently short between **Drain** and **Source**, continuously operating whatever load they drive. This short can be easily detected in-circuit with an ohm meter. This **GDS** configuration applies to the D-Pack SMD Mosfets.

Integrated Circuits

Most IC's will have their part identity printed on the top, even if it has been abbreviated somewhat. Before removing any IC, record its orientation with a sketch or photo, so that its replacement will be mounted using the same orientation.

The conventions for IC pin numbering can be somewhat obscure. Most PCBs will have a printed outline under the chip showing orientation with a notch at one end, but don't count on it.



While often vague, there is normally some identifying information present

Pin 1 of any chip is usually identified with a small dot, or dimple. Sometimes Pin 1 is close to a corner that has been flattened slightly. Many ICs have a bar printed across one end to signify the top of the chip. If the chip is oriented with the bar to the top, then the top-left corner will be Pin 1.

If none of that is visible, look for a slight bevel along one edge of a chip. The left-hand end of a bevelled chip will be Pin 1.

Once Pin1 has been located, count anticlockwise around the perimeter of the device for Pin 2, 3 etc.

Size Selection

When looking at catalogue images of a part it is easy to get the scale of SMD components wrong. You may buy a size quite different to what was expected.

This happened in the adjacent example. (shown here on a postage stamp.) A 6-pin Digital to Analog Converter (DAC) chip was required for a project to produce a 0 to 10V output. A footprint was provided for it on a PCB, but when the time came to fit the chip, it was much smaller than expected. It would not fit to the prototype board without delicately adding hair-fine link-wires to each leg of the chip.



*This chip, just 3mm long is laser labelled as **AJ2Y**, with **Pin 1** being below the 'A'*



The tiny DAC chip (circled) was difficult to use

In electronics design work a lot of attention to detail is required to prevent these sorts of problems. It is good practice to have component samples on hand before designing any circuit board which will accommodate SMDs.

A secondary issue with this chip was that there was no obvious marking for **Pin 1**. There were no apparent

dimples or bevels. Which way did it go? Soldering it in backwards would likely result in its destruction. Usually there is only one chance to correctly place an SMD.

Once the chip was placed under a microscope, a barely legible laser engraving could be seen. It read **AJ2Y**, representing the part **MCP4725**. The orientation of the text was the clue. **Pin 1** of the chip was below the letter 'A' with remaining pins counted anti-clockwise around the perimeter from that point.

Another trap for the device will be available style.

The adjacent image microprocessors, plus chips shown here are completely different in single letter in the denote the package

With a little patience, serviced by most removed and re-difficulty. The bottom version in the 'super-compact' package is much harder to work with.



These two smd devices are electrically identical

experimenter is that the same in more than one SMD package

shows two Atmel AT90PWM3B a ¼ watt resistor for scale. The electrically identical, but physically size and shape. A component suffix is changed to size.

the larger version can be experimenters. This style can be soldered without too much

Manipulating SMD Parts

The modern electronics workshop has an array of specialised tools for working with tiny components. There are excellent miniature pen-shaped vacuum tools that will suck a part to a tiny plunger, which may then be relocated as required. Most amateurs will be reluctant to spend money on such tools unless a lot of SMD work is planned.

It is worthwhile to assemble a second, compact toolbox dedicated to SMD tools only. Fine pointed tweezers, fine brushes, cotton buds and a fine needle for scraping between pins. An excellent tool is to sacrifice a pair of pointy-nose pliers by bending the last 10mm inwards to create a pincer grip. With this tool an SMD IC can be grasped by its ends as an aid for placing and removing IC's. (see the section on soldering/de-soldering)

Another simple, inexpensive tool is the 'Reverse Tweezer', which can hold an SMD under its own spring tension. These are great for picking up SMD resistors and capacitors without the part 'disappearing' the moment the grip is relaxed.



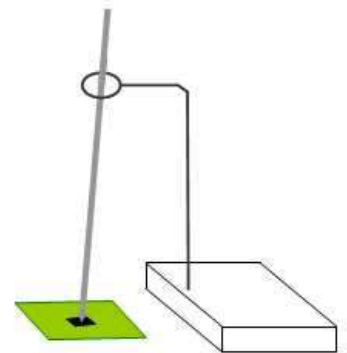
These reverse tweezers available from most electronics stores are very useful with discrete SMDs

One of the largest challenges for soldering SMDs is having them wander all over the PCB while trying to solder them into position. Whilst soldering, SMDs must be precisely located and held in place with a slight downward pressure to provide full contact with the pads.

Here is a design for a simple tool that is surprisingly useful for this task. Essentially, it is a block of heavy wood or metal. From this block a length of coat hanger wire is bent to create an inverted L with a loop at the end. This creates a basic vertical support.

Next, prepare a short length of solid steel rod, around 6mm diameter and 400mm long. One end should be filed or ground to a dull point, about 1mm in diameter.

The rod is placed vertically through the small loop for support, while the weight of the steel rod gently pins down the SMD as it is being soldered. This basic tool can save a lot of time when soldering SMDs.



This basic tool holds smd parts while they are being soldered

Soldering and de-soldering techniques

This is a big topic and only a few essentials will be covered here. The most important aspect of SMD work is to preserve the condition of the PCB panel at all costs. Copper tracks on SMD boards are thin and vulnerable. Too much heat and physical stress will damage PCB pads. Once a track has lifted or broken away, repairs are difficult and time consuming.

Choice of solder

Many circuit boards are created using lead-free solder. This is fine when automated processes were designed with this solder in mind, but for re-work and small construction projects, traditional 60/40 lead-tin solder is preferred. It has a lower melting point than lead-free solder and this will place less heat stress on circuit board pads during the trauma of re-work.

SMD devices require thin (0.35mm) solder.

A fine tipped, temperature-controlled soldering iron is recommended, but access to thin solder is essential. Generally, it is good to have the full trio of 0.35mm, 0.71mm and 1.25 mm solder on hand, as each type has a role to play, but the 0.35mm solder will be the workhorse for SMD work.



Having 3 grades of solder on the bench is very handy

Personally, if I were given a choice between having to use a quality soldering station with thick solder only, or fine grade solder and a heated tent peg, I'd go with the tent peg...

Another essential addition is de-soldering braid, which is a resin-soaked copper braid on a small spool; this can absorb solder when heated with an iron. One brand is 'Sodder wick', which despite its poor title, is an excellent product. Generally, they come in compact 1.5 metre spools, making them convenient to manipulate for close work.

Removing SMDs

The removal of surface mount components from a circuit board is not easy, but it can be done. Some SMD parts like resistors and capacitors only have two bonding points, while larger IC's may have a hundred of them.

The best approach is to apply a slight lifting pressure to the component while all bonding points are heated at the same time. The emphasis on 'slight' is important as too much pressure will lift tracks and pads from the board on pins that are still bonded.

In the earlier section, reference was made to modifying long nose pliers to form a pincer. If a component is grasped and the board (if it is not too large) is elevated from the workspace so that it is held a centimetre above the bench, then when all pins have been heated sufficiently, gravity should let the board drop to the bench, leaving the liberated component in the air. Gravity is always better than directly pulling at a part, as the pressure is constant and gentle.

This leaves us with the dilemma of how to heat all bonding points at the same time. By far, the best way to do this is with a blast of focused hot air from a rework station. This is the commercial approach.

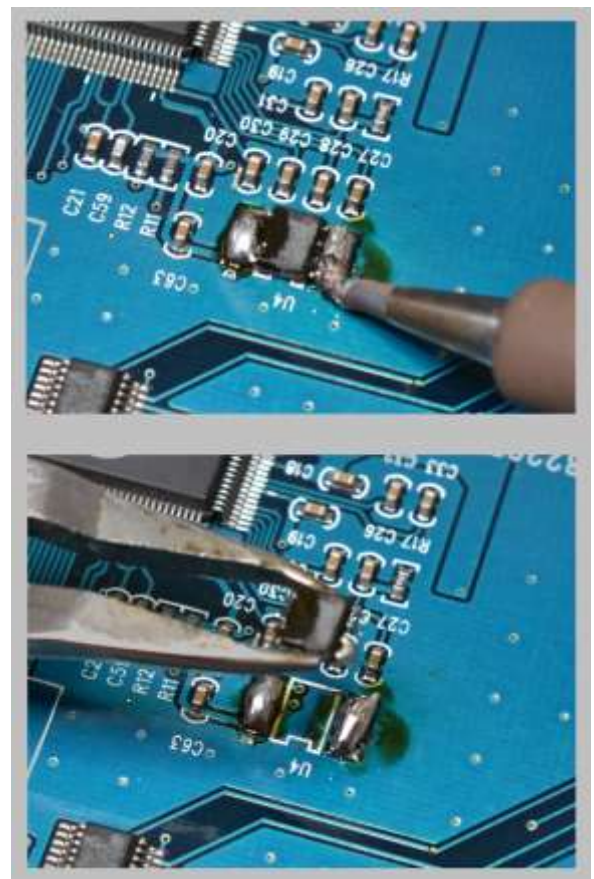
A naked flame from a small torch or gas-powered soldering iron is **not** recommended. The temperature is too extreme, and the PCB can be scorched and pads lifted before the part comes away.

With a little practice, SMD removal can usually be done with a soldering iron. The trick is to select a low temperature, where solder melts, but only just. Then using a thicker solder, such as the 1.25mm size, pile it across all pins so that they are all shorted together with a thick bead of solder. It won't look pretty.

While using a slight lifting pressure on the component (as previously mentioned), go around and around all pins in fairly rapid passes. The thermal mass of the extra solder should keep the pins molten enough between laps and when all pins are sufficiently hot, the component should come away from the board.

The thicker solder has a lot of flux in it, which may seem a bit messy during removal, but this helps the solder flow process.

Don't use solder-sucker tools on SMDs. When the solder is molten enough to be removed, the recoil of the tool will often damage tracks on the board. Likewise, de-soldering braid should not be used to directly remove an SMD as it will never release the bond between the device and the pads under it

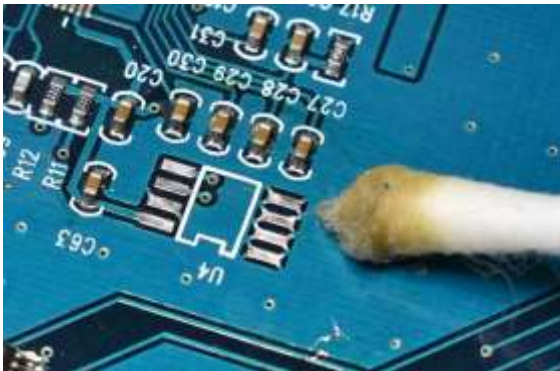


Blob solder across all pins at low temp, then lift the part from the board

Once a component has been lifted from the board, there will be points of solder sitting on most pads which must be removed before a new component can be soldered. This is the correct time to use that de-soldering braid with an iron on a medium heat setting. By heating the braid and gently scrubbing the component area, the pads should clean back to a flat surface. Don't be too vigorous or press too hard as pads may lift from the board.



De-soldering braid is a gentle and focused way to clean up a pcb



Acetone or alcohol on a cotton bud will do a good job of cleaning up a pcb.

Sometimes a single pad of an

IC pin which was never connected to any track will come away from the board, as there was little to hold it in place. If that happens it is best to just ignore it. The circuit should be unaffected.

The final step is to clean the de-soldered area by dissolving any residual resins. Some Isopropyl alcohol on a cotton bud rubbed over the component area will do this. Acetone on a cotton bud also works extremely well for cleaning a PCB.

Soldering SMD parts

There are many strategies for soldering SMD parts and technique may come down to individual preference. We are going to assume that the hobbyist has access to some thin solder (0.35mm) and a reasonably pointy temperature-controlled soldering iron. Without these key items, quality work is going to be difficult to achieve.

There are two different strategies which may be applied depending on the pitch of the component being mounted. If it is discrete, such as a resistor, capacitor, transistor, or an IC with a pitch of 1.5mm spacing or larger, we use the first strategy. For fine pitch ICs we must revert to the second strategy.

Strategy 1 – Soldering discrete parts

With this approach the soldering will be done one pin or pad at a time. Good light and some magnification glasses are probably in order. The key is to correctly place the part, then avoid chasing the part around the PCB with the tip of the soldering iron before it is fully locked into position.

At this point, take time out to examine the footprint on the PCB to see if there are tracks between adjacent pads that are intended to be shorted together. Make a note of any pins that appear to be joined by design. Sometimes, after soldering, these pads can look like solder is accidentally shorting these pins, when in fact these track connection are as designed.

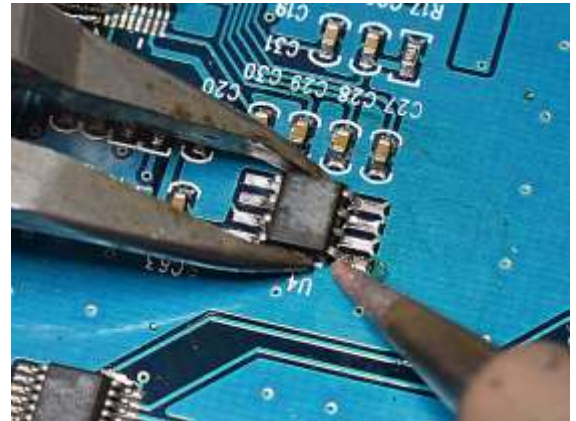
As previously mentioned, it is essential to start with a component pad area where there are no residual solder bumps and lumps, as the new part must be mounted flat and tight to the board. If there is any solder residue, they should first be removed using de-soldering braid.

The next step to part placement is to apply a single blob of solder to just one pad of the component footprint as an anchor. If the component is an IC, then apply the single, fresh solder blob to just one of the pads on a corner pad or row-end pad.

Using tweezers or other supporting tool to hold the component in position, heat up that one solder-blobbed pin (with a low tip temperature) until the component and pin is perfectly aligned to the footprint. .

When the part is successfully anchored by that one pad, you can then solder the adjacent pad, or in the case of an IC, the opposite corner of the component.

This is done while pressing down lightly on the part to ensure it is flat to the board and not floating slightly above it. (Any remaining pins floating above, or out of contact with the PCB pads will be more difficult to solder.) Now, one at a time, gently solder all remaining pins.



Put a blob of solder onto one pin, then sweat the part into position with the soldering iron

If two pins accidentally blob together, don't stop, just keep going until all pins are soldered to their respective pads. To remove any short between pins, apply the end of some de-soldering braid over the affected area to draw the extra solder away and try again.

Once completed, get the magnifying glass out and give it a close inspection.

Strategy 2 – Soldering fine pitch ICs

Soldering some of the fine pitch SMDs without solder paste and a hot-air rework station is always going to be problematic. When IC pins are a mere 0.5mm apart, being armed with the finest of irons, a good shot of whiskey and a steady hand, an experienced technician will still risk some short-circuits between pins.



Once a chip has been positioned, flood-solder the pins, then carefully clean up with de-soldering braid.

One effective solution is to stop trying to avoid such shorts. Begin by using the method described in **Strategy 1**. Carefully place the part and solder the diagonal corners of the device. Then, with a medium sized solder reel, (0.71mm) flood solder across all remaining pins and pads.

Most pins will be shorted, but as long as the pins bond to the pads underneath, it's ok.

Once this has been done, use the de-soldering braid to soak up solder between the pins in a gentle wiping action away from the chip. (doing this sideways along the pins can bend the IC legs)

Even after 90% of the solder has been removed by the braid, each pin should still remain bonded to the pad below.

Take care to ensure the braid does not touch and disturb any other SMD parts which may be close to the IC. Accidentally removing 'extra' parts by accident won't do much to help final circuit operation.

Once the soldering has been completed, there will be a residue of brown resin around the component. Again, this can be cleaned up with a cotton bud dipped in acetone or alcohol.

Wrapping things up

The entire process requires a delicate touch. Like most manual tasks, SMD rework is a skill which will improve with practice and familiarity. Before diving into your favourite \$3,000 transceiver with a hot iron, it's a good idea to find some junk electronics, like a dead DVD player or old monitor and have a go soldering and de-soldering parts. (Even surgeons don't begin their training on 'live' patients.)

, Surface mount componentry is here to stay. It is an integral part of contemporary electronics. Anyone in the field of Amateur Radio who wishes to service or modify commercial equipment must come to terms with this technology.

Some have seen this miniaturisation as a flag signalling the end of their experimentation. It need not be the case.

A willingness to embrace surface mount electronics is simply the opening of a new door to the hobby.

We shouldn't be afraid of entering the world of SMD technology, but when you do pass through that door, remember to take a good magnifying glass with you.



*Manually soldering fine pitch IC's is something
Of an art form, but it is not impossible*

Some more cards from Colin...



TO: Best and
 Confirming your QSO of 14 APR 68 with VK3AT 19
 (GMT) on _____ metres SSB / AM / CW.
 Your RST: _____
 Transmitter: SB-600
 Receiver: _____
 Antenna: 40m Dipole

Thx your card Colin. Get into the mase + sweat up for your Ham ticket!
73 her

NEVILLE M. ROBERTS
 101 Taurimu Road,
 Miramar,
 Wellington,
 New Zealand.



Radio W1A-L3371
 Confirmando QSO WITH - VK2PIN
 En 7 MC mhz. a las 0759 AMT
 Su Señal QSA 5-8
 SSB ☒ AM ☐ CW ☐
 Transmisor SWAN 500
 Receptor _____
 Antena DB24 HYGAIN-2 EL

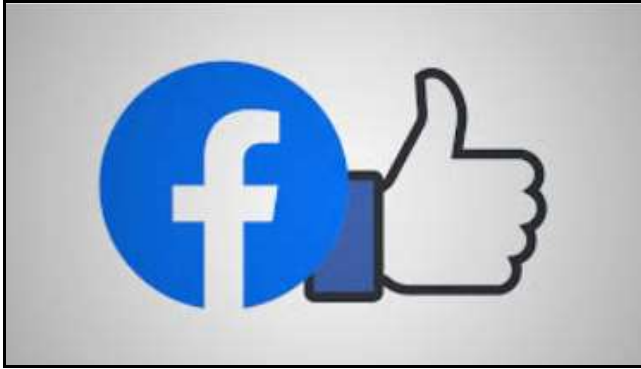
LMRE ARRL CRANTAC
 THANKS FOR A NICE
 QSL - HOPE TO QSO.
 DIRECT WITH YOU
 ¡Saludos! Rail

Gracias por QSO - 73 y DX - Agadeczo QSL

Social Media Resources

VK Facebook Groups

Love it or hate it, here are some links to VK Facebook groups that may be of interest.



VK Home Brew

<https://www.facebook.com/groups/1689037384702683/>

FISTS – Morse code Preservation Society

<https://www.facebook.com/groups/1765058520392148/>

WWFF Australia – portable operating

<https://www.facebook.com/groups/1805720889702979/>

SOTA – portable operating – Summits on the Air

<https://www.facebook.com/SotaAustralia/>

VK DMR Network

<https://www.facebook.com/groups/743300879089972/>

VK QRP Club

<https://www.facebook.com/groups/VKQRPClub/>

80 metre FT8 DXing

<https://www.facebook.com/groups/1609856205711413/>

QRM Guru – dealing with QRM/RFI

<https://www.facebook.com/qrmguru/>

Radio Amateurs Old Timers Club

<https://www.facebook.com/groups/1545441272389468/>

Amateur Radio Sales Australia

<https://www.facebook.com/groups/768281943267696/>

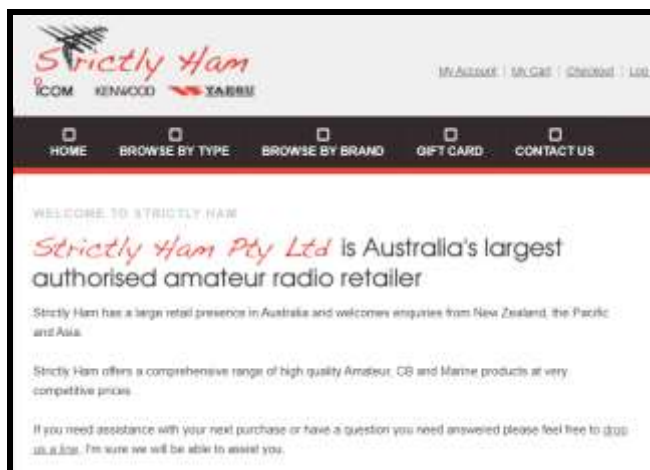
VK Contests

<https://www.facebook.com/groups/1239479436169142/>

If you see we've overlooked something, please send us an email editor@qtcmag.com

VK Suppliers of AR Products





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